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New species in *Cortinarius* section *Cortinarius* (Agaricales) from the Americas and Australasia

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Abstract

Five new species from *Cortinarius* sect. *Cortinarius* are formally described, four from the Americas (*Cortinarius palatinus* Harrower, **sp. nov.**, *Cortinarius atrotomentosus* Harrower, **sp. nov.**, *Cortinarius altissimus* Harrower & T.W. Henkel, **sp. nov.**, *Cortinarius neotropicus* Harrower, **sp. nov.**) and one from Australasia (*Cortinarius carneipallidus* Harrower & E. Horak, **sp. nov.**) based on molecular, morphological, and ecological circumscription. Additional collections of the Australasian species *Cortinarius hallowellensis* Wood and *Cortinarius kioloensis* Wood reveal wider host associations and geographic ranges than previously recorded. Morphological descriptions, photomicrographs and a dichotomous key to all species in *Cortinarius* sect. *Cortinarius* are provided. This work raises the number of species in sect. *Cortinarius* to twelve.

Key words

Australia, Costa Rica, Guyana, New Zealand, North America, South America, systematics, taxonomy

Introduction

Recent phylogenetic analyses of Harrower et al. (2015) have revealed greater species-level diversity in *Cortinarius* (Pers.) Gray sect. *Cortinarius* (also known as the *C. violaceus* group) than previously thought (Bougher and Syme 1998, Halling and Mueller

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2005, Gasparini and Soop 2008). Phylogenetically defined species within the section exhibit continental scale disjunct distributions and form ectomycorrhizal associations with different plant partners (Harrower et al. 2015). Taking their morphological differences into consideration, a taxonomic revision of the section is warranted.

Cortinarius subgenus *Cortinarius* sect. *Cortinarius* is an easily identifiable section within the very large genus *Cortinarius*. All basidiomata have a deep violet color, the pigment of which has been identified as (R)-3',4'-dihydroxy-β-phenylalanine [(R)-β-dopa] in *Cortinarius violaceus* (L.) Gray (von Nussbaum et al. 1998). The pigment is vacuolar, encrusting (Brandrud 1983) and oxidizes quickly to brown (von Nussbaum et al. 1998). The following features for the section were noted by Brandrud (1983), the circumscription of which as based on European taxa only at the time. The pileus is tomentose to finely scaly (comprising a trichoderm), neither hygrophanous nor viscid. KOH on any surface of a basidiome produces a red reaction. Pleurocystidia and cheilocystidia are present, none of which differ in size, shape and abundance and caulocystidia are present. The basidiospores of all species are verrucose and bear a plage.

Linnaeus (1753) described the first species in the section as *Agaricus violaceus* L. Persoon (1801) recognized *A. violaceus* ("ad margines sylvarum") and *A. hercynicus* Pers. ("in pinetis"). However, the latter was synonymized with *A. violaceus* by Fries (1821). Moser (1967; 1969) later recognized *Cortinarius hercynicus* (Pers.) M.M. Moser as an autonomous species. Brandrud (1983) treated the two species as varieties and later as a subspecies (Brandrud 1990), but Harrower et al. (2015) did not find a genetic or ecological basis for distinguishing these taxa.

Clements and Shear (1931) designated *C. violaceus* (L.) Gray as the type species of the genus *Cortinarius*. The subgenus *Cortinarius* was circumscribed by Orton (1958) to include *C. violaceus*, *C. orellanus*, *C. cotoneus* and other allied species. Moser (1967, 1969) transferred members of the *C. orellanus-cotoneus* group into subgenus *Leprocybe* sensu Moser, leaving subgenus *Cortinarius* represented by only *C. violaceus* and *C. hercynicus*. Niskanen et al. (2008) included sections *Cortinarius*, *Dermocybe*, *Veneti*, *Limonii*, *Orellani* and *Humicolae* within subgenus *Cortinarius*.

As many as twelve species have been recognized in sect. *Cortinarius*, but the inclusion of some these species is suspect. Members are known on every continent except for Africa and Antarctica (Moser 1968, Brandrud 1983). *Cortinarius violaceus* occurs throughout North America, Asia and Europe in association with members of the Fagales, Salicaceae and Pinaceae (Brandrud 1983; Nezdoiminogo 1996; Harrower et al. 2015). Horak (1980) described *C. gayi* Horak from *Nothofagus* in Chile for *C. violaceus* Fr. sensu Montagne (Montagne 1989). Singer et al. (1983) described *Cortinarius kerrii* Singer & I.J.A. Aguiar from the Amazon in campinarana vegetation. Moser (1987) documented *C. violaceus* Fr. as occurring in mixed deciduous forests in Malaysia and Papua New Guinea. In the same paper, he described *C. atroviolaceus* M.M. Moser, *C. subcalyptrosporus* M.M. Moser and *C. paraviolaceus* M.M. Moser from Mt. Kinabalu, Sabah, Malaysia. Malaysian plant associates were likely in the plant families Fagaceae and Myrtaceae (Beaman et al. 2000, Beaman and Anderson 2004), and Moser also documented *C. atroviolaceus* and *C. subcalyptrosporus* as occurring with *Nothofagus* in

New Zealand (Moser 1987). He was uncertain whether *C. paraviolaceus* belonged in sect. *Cortinarius* due to the lack of cheilocystidia, atypical pleurocystidia, a pileus that is not strongly squarrose-fibrillose-squamulose and basidiomata that are less intensely violet (Moser 1987). Moser also described *C. atrolazulinus* M.M. Moser with *Nothofagus* in New Zealand (Moser 1987). Gasparini (2001) added *C. austroviolaceus* Gasparini from Australia. This species was excluded from the *C. violaceus* group by Harrower et al. (2015) due to a lack of pleurocystidia and phylogenetic placement outside the clade containing *C. violaceus*. Wood (2009) described *C. jenolanensis*, *C. kioloensis* and *C. hallowellensis* from *Eucalyptus* forests in Australia, but the former lacks pleurocystidia suggesting to us an alliance outside the *C. violaceus* group. Assuming *C. hercynicus* is treated as a synonym of *C. violaceus* then twelve species can be recognized in sect. *Cortinarius*.

Harrower et al. (2015) produced a multi-gene phylogenetic tree that delimited eight different species present in sect. *Cortinarius* in the Americas and Australasia. Species were separated by at least a 2% difference in the ITS region, which conforms to the benchmark in *Cortinarius* established by Stephani et al. (2014). Of the eight species level lineages detected, two new were found in Costa Rica, one in North America, one in New Zealand, and one in Guyana. Here we provide descriptions for all species recognized in this previous study (except for *C. violaceus*). Additional collections of *C. kioloensis* and *C. hallowellensis* (Wood 2009) have been examined extending their known host association and geographic ranges. The purpose of this study is to revise the taxonomy of species in the *C. violaceus* group found in Australasia and the Americas and refine sect. *Cortinarius* based on morphological data previously confirmed by molecular phylogenetic results. A key to twelve species in the section is provided.

Methods

Dried specimens of collections labeled as *C. violaceus*, *C. subcalyptrosporus*, *C. atroviolaceus*, *C. atrolazulinus*, and *C. austroviolaeus* were obtained from the TENN, ZT, HSC, NY, PDD and PERTH herbaria. Additional collections were provided from Ian Dodd (West Kempsey, Australia). Requests for type collections of *C. subcalytrosporus*, *C. atroviolaceus*, *C. atrolazulinus* and *C. paraviolaceus* were denied from the IB herbarium. Previous attempts to sequence *C. subcalyptrosporus* and *C. paraviolaceus* were purportedly unsuccessful (Ursula Peintner, personal communication).

Morphological analysis

Macroscopic descriptions were taken from fresh material as described by collectors where possible. Color documentation of basidiocarps follows the Methuen Handbook of Colour (Kornerup and Wanscher 1967). When no descriptions were made from fresh material, macroscopic descriptions were assembled from dried material and from photographs of fresh material. By measuring the pileus diameter and stipe length of

MEL 2351101 (*C. kioloensis*) before and after drying, it was estimated that basidiomata were reduced by a factor of 1.75 upon drying. Macroscopic measurements were taken from dried specimens of *C. atrotomentosus* sp. nov., *C. neotropicus* sp. nov., *C. kioloensis* and *C. carneipallidus* sp. nov. Dry measurements were multiplied by a factor of 1.75.

Microscopic features were observed from sections of dried material rehydrated in 5% KOH on a Nikon Eclipse 80i microscope. Basidiospore measurements were taken from spores trapped in the cortina on the stipe. However, for specimens that did not have any remaining cortina, basidiospore measurements were taken from lamellar tissue, and mature basidiospores (judged by the presence and development of ornamentation) were measured at random. Measurements were taken with a Nikon DS-Fi1 camera and Nikon NIS Elements 3.1 software. Twenty-five basidiospores were measured per collection. Outliers are placed in parentheses. Five basidia, cheilocystidia, and pleurocystidia were measured per specimen. The following abbreviations are used: Q = quotient of length divided by width; Q mean = average value of Q values. Scanning electron microscope images were taken on a Zeiss Auriga scanning electron microscope. Lamellae were placed on double-sided carbon adhesive tape and covered with two layers of a gold sputter coating.

Phylogenetic study

Methods for DNA extraction, PCR amplification, and sequencing are given in Harrower et al. (2015). Fig. 2 in Harrower et al. (2015) is summarized here in part as Fig. 1, showing the phylogenetic relatedness of species within sect. *Cortinarius*.

Taxonomy

Cortinarius Fr. subgen. *Cortinarius* sect. *Cortinarius*

Synonyms: *Agaricus* (ser. *Cortinaria*) trib. *Inoloma* Fr.: Fr. 1821: 217. – *Agaricus* subgen. *Inoloma* (Fr.: Fr.) Loudon 1836: 1000. – *Cortinarius* Fr. 1836 trib. *Inoloma* (Fr.: Fr.) Fr. 1836: 279. – *Inoloma* (Fr.: Fr.) Wünsche 1877: 87. – Type species: *Cortinarius violaceus* (L.:Fr.) Gray.

Type species. *Cortinarius violaceus* (L.:Fr.) Gray

Basidiomata tricholomatoid, deep violet; pileus squamose to tomentose, rarely greasy, then simply innately fibrillose; KOH+ red; basidiospores subglobose, ellipsoid to amygdaliform, weakly to strongly verrucose, with suprahilar plage (may only be visible in SEM); pleurocystidia and cheilocystidia present; caulocystidia present or usually absent; pileipellis a trichoderm of hyphae (6–22 μm wide) or rarely an ixocutis with gelatinized hyphae (2–11 μm wide); pigment vacuolar and soluble in water, violet often turning brownish in age.

Key to species of *Cortinarius* sect. *Cortinarius*

1	Pileus smooth, greasy; pileipellis an ixocutis	***C. hallowellensis***
–	Pileus scaly, dry; pileipellis a trichoderm	**2**
2	Stipe more than two times longer than the width of the pileus	***C. altissimus***
–	Stipe less than twice as long as the width of the pileus	**3**
3	Basidiospores with a visible perisporium	***C. subcalyptrosporus***
–	Basidiospores without a loosening of the perisporium	**4**
4	Cheilocystidia 25–30 × 9.5–11.5 µm	***C. kerrii***
–	Cheilocystidia larger than above	**5**
5	Basidiospores 9–12.5 × 5.5–6.5 µm; Q=1.86; basidia 32–38 × 7.5–8 µm	***C. atrolazulinus***
–	Basidiospores often longer, less elongate; Q<1.86; basidia width > 8 µm	**6**
6	Growing on calcareous soil with *Quercus virginiana*	***C. atrotomentosus***
–	Growing on a variety of soils; not with *Quercus virginiana*	7
7	Basal mycelium white	***C. neotropicus***
–	Basal mycelium pale violet	**8**
8	Caulocystidia present	***C. violaceus***
–	Caulocystidia absent	**9**
9	Occurring with *Quercus* in Costa Rica	***C. palatinus***
–	Occurring with Myrtaceae or *Nothofagus* in Australasia or Fagaceae in Indonesia	**10**
10	With *Nothofagus*	***C. carneipallidus***
–	Not with *Nothofagus*	**11**
11	Occuring with Myrtaceae in Australia and New Zealand	***C. kioloensis***
–	Occuring with Fagaceae in Indonesia	***C. atroviolaceus***

***Cortinarius kioloensis* Wood, 2009**
Figs 1, 2a, 3a, 4a

Type. AUSTRALIA. New South Wales: Batemans Bay, Kioloa State Forest, Eucalypt woodland, 22 Jun. 1980, S. Lowry (holotype: UNSW 83/781).

Description. Pileus 45–120 mm wide, convex to plano-convex with a low, broad umbo with age, surface dry, tomentulose-squamulose, dark violet (17F8), lighter concolorous (17E3) near margin, red in KOH; margin entire, split and broadly undulating with age. Lamellae close, sinuate, thick, broad to ventricose, deep blue (19D–E8). Stipe 105–165 mm long, 7–28 mm thick at apex, 9–31 mm thick at base, bulbous, light violet (18A3–5) turning deep blue (18F8) upon touch because of the copious universal veil. Universal veil pale violet (17A3). Basal mycelium pale violet (17A3). Context at apex dark violet to black (18F8).

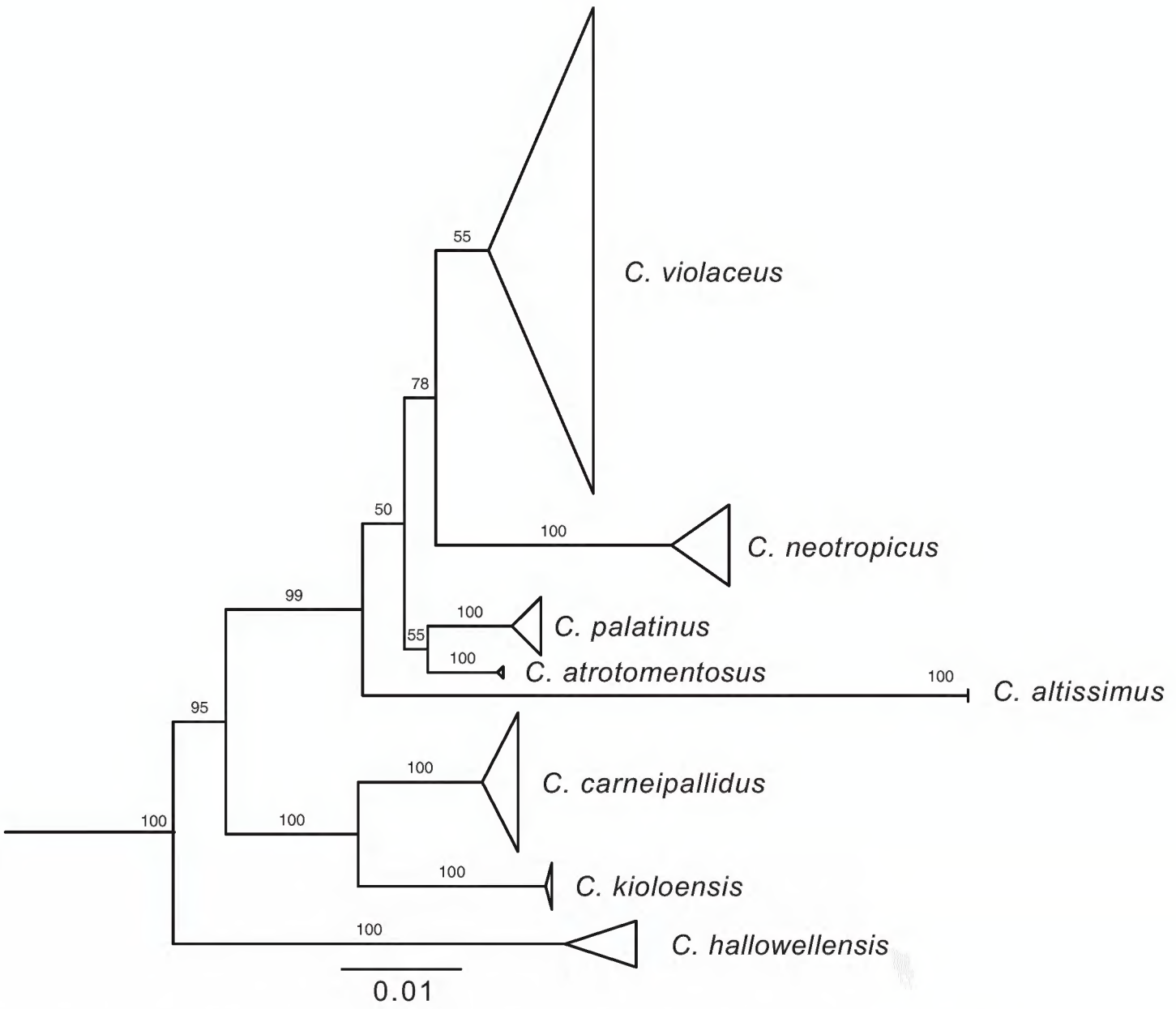

Figure 1. Maximum likelihood (ML) phylogenetic tree of *Cortinarius* subgen. *Cortinarius* sect. *Cortinarius* using combined nuclear ITS, 28S and *RPB2* sequences. ML bootstrap support above 50% is shown above nodes.

Basidiospores 10.5–14 µm × 6.5–9 µm, means = 11.5–12.5 µm × 7.5–8 µm, *Q* = 1.41–1.63, *Q* means = 1.45–1.60 (125 spores, 5 specimens), ellipsoid to amygdaloid, strongly verrucose, plage present under SEM. Basidia 4-spored, clavate, (27) 35–49 µm × 8–12 µm. Cheilocystidia ventricose to lageniform, sometimes strangulated, brown in KOH, (50–) 60–100 (–127) µm × (10–) 15–30 (–35) µm. Pleurocystidia narrowly conical to lageniform, sometimes strangulated, brown or grey in KOH, (50–) 60–90 (–105) µm × (15–) 20–25 (–30) µm. Caulocystidia absent but brown vacuolar pigment in some hyphae of the caulopellis. Pileipellis a trichoderm composed of fasicles of multiseptate hyphae, 8–20 µm wide, smooth, terminal cells clavate to lanceolate, with brown contents in KOH. Clamp connections present.

Ecology and distribution. With *Eucalyptus* and/or *Allocasuarina* in southeast Australia. With *Leptospermum* in New Zealand. Fruiting April to July.

Other specimens examined. Australia. Tasmania: Florentine River Valley, Pagoda Hut, on soil under *Eucalyptus* and *Allocasuarina*, 23 Apr. 2003, D.A. Ratkowsky

(MEL 2351101). New South Wales: Swans Crossing State Forest (*Eucalyptus*), 21 May 2003, I. Dodd 70845 (TENN 069666). New Zealand. Auckland: Waitakere Ranges, Little Huia, Donald Mclean Track, 10 July 2010, C. Shirley AK375 (PDD 99307). Auckland: Waitakere, Piha Rd, Upper Nihotupu Dam track, (*Leptospermum*), 24 July 2010, C. Shirley AK373 (PDD 99309). Auckland: Waitakere, Mountain Rd, Opanuku Pipeline Track, (*Leptospermum*), 17 July 2010, C. Shirley AK370 (PDD 99308).

Discussion. The collections examined here match the protologue of *C. kioloensis* Wood in all particulars. One collection (TENN 069666) was seen to have dark purple, nearly black flesh at the apex. Flesh color at the base was not observed. We have not studied the type of this species (the collection was not readily available at UNSW) but are confident for now applying the name *C. kioloensis* to our material. As such, the species range has been extended from N. S. W. into Tasmania and New Zealand and a new host association with *Leptospermum* has been revealed. *Cortinarius atroviolaceus* and *C. kioloensis* cannot be distinguished morphologically, but the two are geographically separated and likely ecologically differentiated. *Cortinarius atroviolaceus* is found at 1700 m on Mt. Kinabalu, Malaysia where *Leptospermum* (Myrtaceae), *Trigonobalanus* (Fagales), *Quercus* (Fagales), *Lithocarpus* (Fagales), and *Castanopsis* (Fagales) may occur (Beaman et al. 2000; Beaman and Anderson 2004). *Cortinarius kioloensis* is found with *Eucalyptus* (Myrtaceae) and/or *Allocasuarina* (Casuarinaceae) in southeastern Australia and with *Leptospermum* (Myrtaceae) in New Zealand. Herbarium collections of *C. kioloensis* from New Zealand have been misidentified as *C. subcalyptrosporus*. *Cortinarius kioloensis* differs from *C. subcalyptrosporus* by the non-calyptrate basidiospores. It differs from *C. atrolazulinus* by association with Myrtaceae, not Nothofagaceae. *Cortinarius kioloensis* is also similar to *C. carneipallidus*, a *Nothofagus* association, but differs from this latter species by association with Myrtaceae. Phylogenetic results (Fig. 1) also support these separations. Unique molecular synapomorphies are present at pos. 11, 35, 203 (ITS1), 475, 554, 577, 578, 623 (ITS2) of our alignment. *Cortinarius kioloensis* was treated as "*C.* sp. AU1" in Harrower et al. (2015).

Cortinarius palatinus **Harrower, sp. nov.**
MycoBank MB 811657
Figs 1, 2b, 3b, 4b

Diagnosis. Similar to *Cortinarius neotropicus* sp. nov. but differs in having shorter basidiospores and absence of caulocystidia. Unique molecular synapomorphies at pos. 39 (ITS1), 524, 618, 649, 651, 672 (ITS2) of our alignment.

Type. COSTA RICA. San Jose: Perez Zeledon, Villa Mills, CATIE Experimental Forest, 9°33'03"N; 83°40'56"W, 2880 m alt., (*Quercus costaricensis*), 21 June 2003, R.E.Halling 8411 (holotype: NY 796168).

Etymology. Named for the color palatinate, a shade of violet.

Figure 2. Habit of the following *Cortinarius* species: **a** *C. kioloensis* (TENN 069666, photo I. Dodd) **b** *C. palatinus* (NY 796168, TYPE photo R.E. Halling) **c** *C. atrotomentosus* (TENN 069922, photo A. Bessette); **d** *C. hallowellensis* (MEL 2300544) **e** *C. neotropicus* (NY 75934, photo R.E. Halling) **f** *C. carneipallidus* (PDD 71219, photo E. Horak) **g** *C. altissimus* (TENN 069829, TYPE photo T. Henkel); **h** *C. gayi* (ZT 75/82, ISOTYPE photo E. Horak) **i** *C. austroviolaceus* (MEL 2231689, photo K. Syme). Scale bar = 1 cm.

Description. Pileus 30–50 mm wide, convex to plano-convex, surface dry, densely squamulose, appressed toward margin, erect on disc, violet (15C5–8, 15D5–8, 15E5–8, 16C5–8, 16D5–8, 16E5–8), red with KOH. Lamellae adnexed, close, violet, concolorous with pileus, soon assuming brown colors, up to 1 cm broad, edges even to uneven. Stipe 80–120 mm long, 10–14 mm broad, equal or subclavate, strict or curved, dry, upper half violet, fibrillose–striate; lower half pale violet, fibrillose, base violet (15C5–8, 15D5–8, 15E5–8, 16C5–8, 16D5–8, 16E5–8). Universal veil pale violet. Context pale violet, unchanging. Smell mild. Taste mild.

Basidiospores 11–15 µm × 7–9.5 µm, means = 12–13 µm × 8–8.5 µm, *Q* = 1.39–1.59, *Q* means = 1.40–1.53 (150 spores, 6 specimens). Amygdaloid, strongly verrucose, plage present under SEM. Basidia 2- and 4-spored, clavate, (20–) 30–40 × 10–15 µm. Cheilocystidia present but not abundant in younger specimens, lageniform, brown or grey in KOH, (35–) 60–95 (–100) µm × (11–) 13–25 (–30) µm. Pleurocystidia abundant, lageniform, brown or grey in KOH, (40–) 50–80 (–105) µm × (10–) 15–25 (–40) µm. Pileipellis a trichoderm composed of hyphae up to 20 µm wide, multi-septate, with brown contents in KOH, terminal hyphae blunt-ended, sometimes aciculate. Clamp connections present.

Ecology and distribution. Known from Perez Zeledon and San Gerardo de Dota in Costa Rica. Associated with *Quercus copeyensis*, *Q. seemannii*, and *Q. costaricensis* on acidic soils. Occurring mid-June to mid-July. Elevation 2220–2280 m.

Other specimens examined. Costa Rica, San Jose, Perez Zeledon, Villa Mills, CATIE Experimental Forest, 9°33'03"N; 83°40'55"W, 2880 m, (*Quercus costaricensis*), 22 June 1995, R.E.Halling 7450 (NY 79537). San Jose, San Gerardo de Dota, Albergue de Montana, Savegre, ~5 km SW of Cerro de la Muerte, 9°33'02"N; 83°48'27"W, 2500 m, (*Quercus copeyensis*, *Q. seemannii*), 20 June 1994, R.E.Halling 7307 (NY 34724). San Jose, Perez Zeledon, Villa Mills, CATIE Experimental Forest, 9°41'56"N; 83°56'31"W, 2850 m, (*Quercus costaricensis*), 12 June 2000, R.E.Halling 8184 (NY 795933). San Jose, San Gerardo de Dota, Albergue de Montana, Savegre, ~5 km SW of Cerro de la Muerte, 9°33'02"N; 83°48'27"W, 2220 m, (*Quercus copeyensis*, *Q. seemannii*), 10 July 2001, R.E.Halling 8004 (NY 460906). San Jose, Perez Zeledon, Villa Mills, CATIE Experimental Forest, (*Quercus costaricensis*), 23 June 2001, E. & A. Horak (ZT 10422).

Discussion. *Cortinarius palatinus* sp. nov. is treated as '*C.* sp. CR2' in Harrower et al. (2015). It occurs in the same oak forests and at the same elevation as *Cortinarius neotropicus* sp. nov. It can be distinguished from *C. neotropicus* sp. nov. by its larger and more heavily verrucose basidiospores and pale violet context. Caulocystidia were found in *C. violaceus* and *C. neotropicus* sp. nov., but not in *C. palatinus* sp. nov. *Cortinarius atrotomentosus* sp. nov. differs from *C. palatinus* sp. nov. by its wider and olive colored stipe. These two species appear to be most closely related (Fig. 1). *Cortinarius atrotomentosus* sp. nov. occurs on limestone soil and *C. palatinus* sp. nov. on acidic soil. This is the same species that was referred to as *C. violaceus* by Halling and Mueller (2005) from the Talamanca Mountains of Costa Rica (NY795933 illustrated).

Cortinarius altissimus **Harrower & T.W. Henkel, sp. nov.**
MycoBank MB 811658
Fig 1, 2g, 3c, 4c

Diagnosis. Similar to *Cortinarius kerrii* Singer & I.J.M.Araujo but differs by its larger basidia and less frequent, much larger pleurocystidia. Unique molecular synapomorphies at pos. 46, 108, 156, 212, 216, 259, 260, 261, 262, 264 (ITS1), 440, 503, 506, 532, 545, 554, 583, 617 (ITS2) are present in our alignment.

Type. GUYANA. Region 8 Potaro-Siparuni: Pakaraima Mountains, Upper Potaro River Basin, vicinity of Potaro base camp at 5°18'04"N; 59°54'40"W, 710 m alt., on lateritic soils; 2 km southeast of base camp near *Dicymbe* plot 1, on humic mat of forest floor under *Dicymbe corymbosa*, May 25 2001, T.W.Henkel 8211 (holotype: BRG 41220; isotype TENN 069829, HSU G1168)

Etymology. Refers to the exceptionally tall basidiomata of the species, due to the long stipe.

Description. Pileus 24–56 (–87) mm wide, 17–29 mm tall, convex to planoconvex with a low, broad umbo with age, surface dry, erect tomentulose-squamulose throughout, especially over disc, under hand lens squamules subpyramidal and subacuminate, 0.5 mm tall, dark violet (16F7–16F8, 17F7–17F8), lighter concolorous (16E8) near margin, red in KOH; margin entire, broadly undulating with age. Lamellae subclose, shallowly adnexed with short decurrent tooth, subthick, 2 mm broad at margin, 8–10 mm centrally, 7 mm at stipe, concolorous (16F5–17F5), browning with basidiospore development; edges concolorous, hispid under hand lens; lamellulae usually 3 (2 short at 1–3 mm, 1 long at 6–21 mm), occasionally 5, rarely 7. Stipe 132–220(–263) mm long, (2–) 5–11 mm thick at apex, (3–) 7–17 mm thick at center, (7–) 12–24 mm thick at base, subequal, tapering gradually from base to apex, concolorous (16F5–16F6) or slightly lighter concolorous (16D7–16E7, 17D7–17E7) over lower 4/5, apex slightly more greyish violet (15D6–15D7), finely longitudinally striate throughout, with appressed longitudinal fibrils visible under hand lens, cartilaginous, snapping easily, red with KOH. Partial veil cortinate, rather scant, concolorous, minimally retained as scattered, rust-brown fibrils on upper stipe and occasionally pileus margin. Basal mycelium a pale purple (16B3–16B4) matted tomentum. Pileus context subsolid, off white to light purple (17A4–17B4), unchanging, 0.5–1 mm thick at margin, 1–1.5 mm centrally, 6 mm above stipe. Stipe context cartilaginous and concolorous in outer rind, core hollow and off-white, reddening instantly with KOH. Smell mild, slightly fruity to musty. Taste minimal, indistinct.

Basidiospores dark orange–brown (7E7–7E8) in heavy deposit, 10–16 × 8–11 (–13) µm, means = 12–14 × 9.5–11 µm, Q = (1.0–) 1.10–1.44 (–1.56), Q means = 1.18–1.33 (70 spores, 5 specimens), ellipsoid to amygdaloid, verrucose, plage present under SEM. Basidia 4-spored, clavate, (40–) 50–60 (–65) × (8–) 9–15 (–16) µm.

Cheilocystidia scattered to abundant, ventricose-rostrate to lageniform, opaque greyish or brown in KOH, (60–) 70–90 (–100) µm × (10–) 20–30 (–40) µm. Pleurocystidia infrequent, ventricose to ventricose–rostrate, grey or rarely brown in KOH, (60–) 70–110 (–125) × (10–) 25–40 (–45) µm. Pileipellis a trichoderm, organized into discrete, suberect fascicles; hyphae (10–) 15–30 (–35) µm wide, (225–) 270–500 (–550) µm high, light brown in KOH, multiseptate; terminal cells undifferentiated, rounded at apex, or occasionally subclavate. Clamp connections present.

Ecology and distribution. Solitary to scattered on humic mat of forest floor in forests dominated by *Dicymbe corymbosa* (Caesalpinioideae) on lateritic soils; also occurring in forests dominated by *Dicymbe altsonii*, *Aldina insignis* (Papilionoideae), and *Pakaraimaea dipterocarpacea* (Dipterocarpaceae) and *Dicymbe jenmanii* on white sand soils; known only from the Upper Potaro and Upper Mazaruni River Basins in the Pakaraima Mountains of Guyana, in the central Guiana Shield.

Other specimens examined. Guyana, Region 8 Potaro-Siparuni: Pakaraima Mountains, Upper Potaro River Basin, within a 15 km radius of Potaro base camp at 5°18'04"N; 59°54'40"W, 710 m alt., on lateritic soils; 1 km SE of Potaro base camp on Benny's Ridge, (Dicymbe corymbosa), 7 July 2003, T.W.Henkel 8539 (BRG; HSU G1169; TENN 069831). ~15 km E of Potaro base in vicinity of Tadang base camp, (Dicymbe altsonii, Aldina insignis), 30 Dec 2009, T.W.Henkel 9180 (BRG; HSU G1170; TENN 069830). 200 m southwest of Tadang base camp (Dicymbe corymbosa, Dicymbe altsonii, Aldina insignis), 6 June 2013, T.W.Henkel 9752 (BRG; HSU G1171). Region 7 Mazaruni-Cuyuni: Pakaraima Mountains, Upper Mazaruni River Basin, within 1 km radius of base camp at 5°26'21"N, 60°04'43"W, ~800 m alt., on white sand soils; 1 km SW of base camp in monodominant stand of Pakaraimaea dipterocarpacea, 25 Dec 2010, T.W.Henkel 9543 (BRG; HSU G1172). Pakaraima Mountains, Upper Mazaruni River Basin, within 1 km radius of base camp at 5°26'21"N, 60°04'43"W, ~800 m alt., on white sand soils; 1 km SW of base camp in monodominant stand of Pakaraimaea dipterocarpacea, 5 June 2012, T.W.Henkel 9690 (BRG; HSU G1173).

Discussion. *Cortinarius altissimus* was treated as '*Cortinarius* sp. SA1' in Harrower et al. (2015). The species has an exceptionally long stipe compared to the width of its pileus, and overall one of the longest stipe lengths recorded in the genus. The size of its basidiospores overlaps with that of *C. kerrii*, which is known from Amazonia. However, the size of the basidia and cystidia are twice that of *C. kerrii*. Additionally, pleurocystidia are infrequent in *C. altissimus* sp. nov. whereas they are abundant in *C. kerrii*. *Cortinarius altissimus* sp. nov. is a prominent member of the ECM fungal assemblage associated with *Dicymbe* monodominant forests in Guyana. In a long-term *D. corymbosa* plot study of Henkel et al. (2012), basidiomata of *C. altissimus* sp. nov. occurred in 5.2% of 630 quadrats sampled during the May–July rainy seasons over seven years. Phylogenetically (Fig. 1), *C. altissimus* sp. nov. is most closely related to other taxa of the *C. violaceus* group that also occur in the Americas.

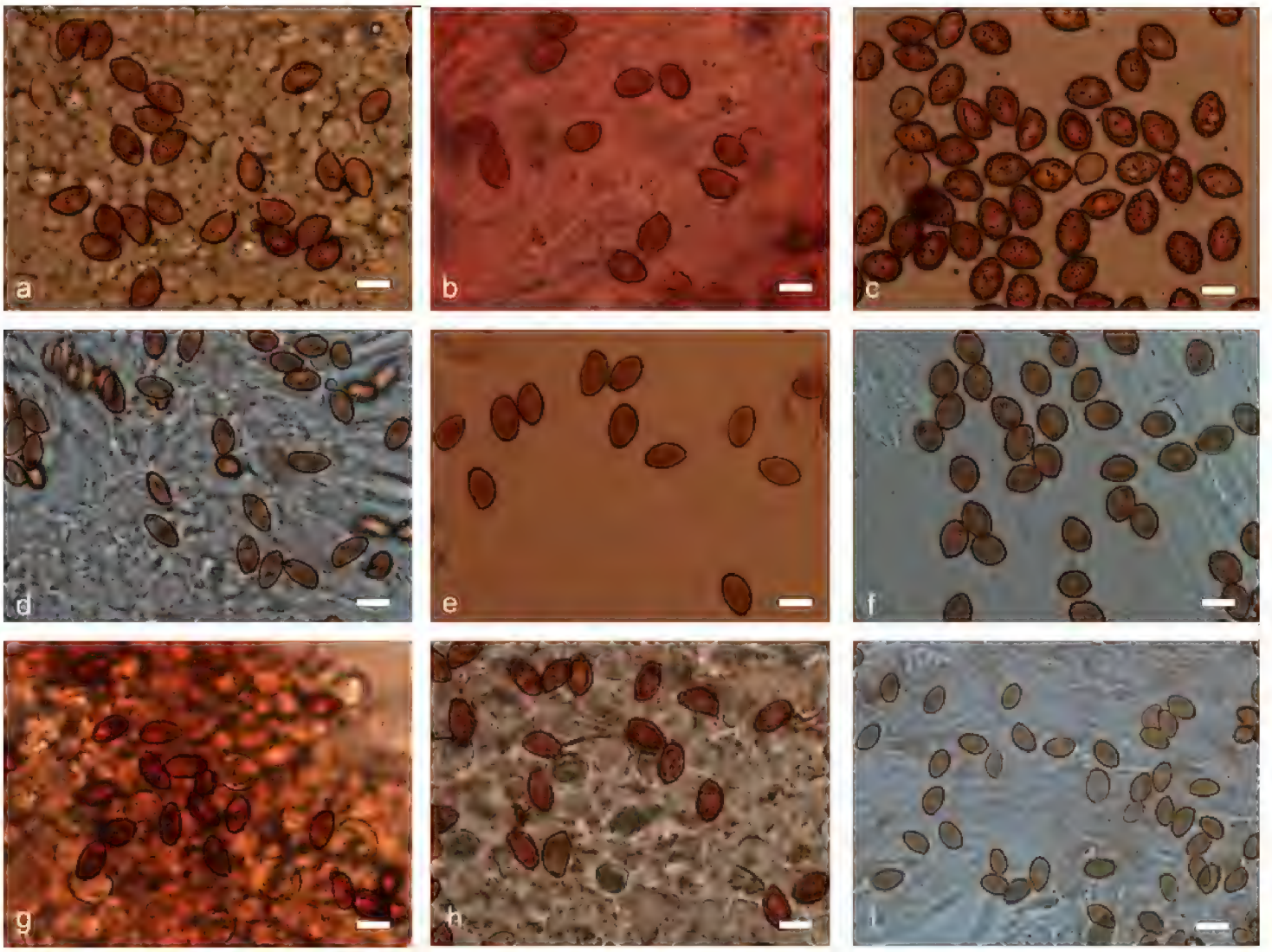

Figure 3. Light micrographs of basidiospores from the following *Cortinarius* species: **a** *C. kioloensis* (PDD 99307) **b** *C. palatinus* (NY 00795933) **c** *C. altissimus* (TENN 069830) **d** *C. hallowellensis* (MEL 2300544) **e** *C. neotropicus* (NY 34729 TYPE) **f** *C. carneipallidus* (PDD 95444 TYPE) **g** *C. atrotomentosus* (TENN 065535 TYPE) **h** *C. violaceus* (TENN 062899) **i** *C. austroviolaceus* (MEL 227499). Scale bar = 10 μm.

Cortinarius hallowellensis Wood, 2009

Figs 1, 2d, 3d, 4d

Type. AUSTRALIA. Western Australia: Mount Hallowell Reserve, (*Eucalyptus*) 22 May 1993 K. Syme (holotype: PERTH005506794).

Description. Pileus 34–90 mm wide, not velvety or velvety smooth, not at all squamulose, greasy when wet, radially innately fibrillose when dry, dark violet (18F4), red in 5% KOH. Lamellae broadly adnexed to adnate, 4–9 mm deep, subdistant, dark violet (16F5), edge smooth, entire, lamellulae abundant in 2 tiers. Stipe 37–80 mm long, 10–30 mm thick, dry, longitudinally fibrillose, cylindrical to clavate with a swollen base, 16F4 (dark violet). Universal veil deep violaceus. Context firm in pileus, fibrous in mature stipe, pallid, tinged purplish (16A2) especially near outside; purple slate/deep purple in stipe and middle of pileus surrounded by speckled white in pileus; yellow-brown at base of stipe. Basal mycelium whitish. Odor not distinctive. Taste none.

Basidiospores (8.5–) 10–13.5 μm × (5–) 6–7.5 μm, means = 10–12 μm × 6–7 μm, Q = 1.55–1.95, Q means = 1.55–1.94, (150 spores, 6 specimens), ellipsoid to

subamygdaliform, moderately verrucose, plage barely noticeable under SEM. Basidia 4-spored, clavate, (25–) 30–50 (–65) µm × 9–12 µm. Cheilocystidia abundant, narrowly fusiform, purple or brown in KOH, (50–) 55–95 (–130) µm × 10–20 µm. Pleurocystidia abundant, narrowly fusiform, purple or brown in KOH, (40–) 50–90 (–105) µm × (5–) 10–15 µm. Caulocystidia not observed. Pileipellis an ixocutis, of even thickness throughout. Hyphae 2.5–11.0 µm wide. Clamp connections present.

Ecology and distribution. With *Eucalyptus*, *Corymbia*, *Melaleuca*, *Allocasuarina*, *Agonis*, and/or *Leptospermum* in Western Australia and Tasmania. Fruiting May and June.

Other specimens examined. Australia. Tasmania: Scamander, Winifred Curtis Scamander Reserve, near Boundary Track (*Allocasuarina verticillata* and *Eucalyptus*), 8 June 2003, D.A. Ratkowsky (MEL 2350466). Hobart, Peter Murrell Nature Reserve. Site HEG. [55G, 524296, 5258469], (*Allocasuarina monilifera*, *Eucalyptus amygdalina*, *Leptospermum scoparium*), 10 July 2001, S. McMullan-Fischer (MEL 2300544). Western Australia: Two Peoples Bay Nature Reserve, Moates Lake access road (*Allocasuarina monilifera*, *Eucalyptus amygdalina*, *Leptospermum scoparium*), 7 May 1991, K. Syme (PERTH 3978729). Cemetery Road near Walpole-Nornalup National Park (*Eucalyptus marginata*, *Corymbia calophylla*, *Agonis flexuosa*, *Agonis parvceps*, *Agonis hypericifolia*, *Allocasaurina fraseriana*, *Melaleuca* sp.), 3 May 1992, K. Syme, N.L. Bougher & M. Hart (PERTH 7581696).

Discussion. *Cortinarius hallowellensis* was treated as '*Cortinarius* sp. AU2' in Harrower et al. (2015). Based on sequencing the type, we have demonstrated that this species occurs in Tasmania as well as Western Australia. *Cortinarius hallowellensis* is unique in the *C. violaceus* group in that it has an ixocutis instead of a trichoderm and is the deepest diverging lineage in the *C. violaceus* clade (Fig. 1). Macroscopically, the pileus is not at all squamulose. The suprapellis is mucilaginous imparting a greasy appearance when wet. The only other species in the *C. violaceus* group found in Australia – *C. kioloensis* is readily distinguished from *C. hallowellensis* by its dry, tomentulose-squamulose pileus. *Cortinarius jenolanensis*, *C. paraviolaceus* and *C. austroviolaceus* lack a squamulose pileus, but unlike *C. hallowellensis*, they lack pleurocystidia and/or cheilocystidia. *Cortinarius hallowellensis* is also referred to as *C. violaceus* by Bougher and Syme (1998) (PERTH 5506794 illustrated). Unique molecular synapomorphies are found at pos. 63, 100, 101, 123, 132, 148, 163, 164, 180, 228 (ITS1), 462, 532, 540, 546, 577, 602, 611, 614, 643 (ITS2) in our alignment.

Cortinarius neotropicus **Harrower, sp. nov.**
MycoBank MB 811660
Figs 1, 2e, 3e, 4e

Diagnosis. Similar to *Cortinarius palatinus* Harrower sp. nov. but differs by its longer basidiospores and presence of caulocystidia. Unique molecular synapomorphies are found at pos. 58, 161, 200, 205 (ITS1), 467, 566 (ITS2) in our alignment.

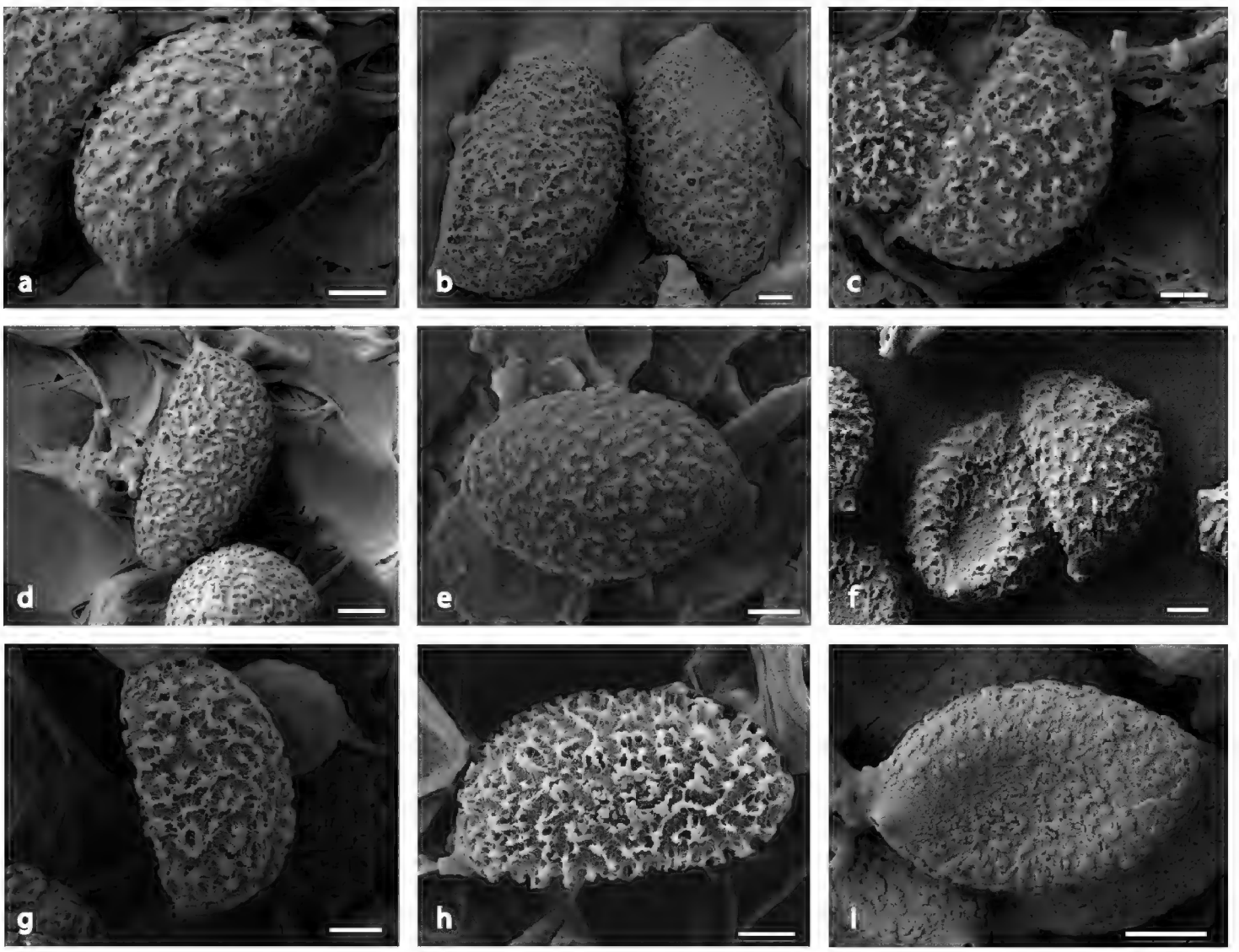

Figure 4. SEM micrographs of basidiospores from the following *Cortinarius* species: **a** *C. kioloensis* (MEL 2351101) **b** *C. palatinus* (NY 796168 TYPE) **c** *C. altissimus* (TENN 069830) **d** *C. hallowellensis* (MEL 2300544) **e** *C. neotropicus* (NY 34729 TYPE) **f** *C. carneipallidus* (PDD 71219) **g** *C. atrotomentosus* (TENN 065535 TYPE) **h** *C. violaceus* (TENN 063104) **i** *C. austroviolaceus* (MEL 2121961 PARATYPE). Scale bar = 2 µm.

Type. COSTA RICA. San Jose: Perez Zeledon, Villa Mills, CATIE Experimental Forest, 9°33'03"N; 83°40'55"W, 2880 m, (*Quercus costaricensis*), 22 June 1994, R.E.Halling 7330 (holotype: NY 34729).

Etymology. Refers to where it is found: the neotropics.

Description. Pileus 28–88 mm wide, convex to plano-convex, surface dry, not hygrophanous, squamulose to appressed squamulose, (18D3-6, 18E3-6), dull violet to greyish violet, red with KOH. Lamellae subdistant, adnexed to adnate, average thickness, ventricose, dark violet (17F2). Stipe 61–149 mm long, 4–16 mm thick at apex, 7–48 mm thick at base, tapering gradually from base to apex, sometimes clavate, dry, 18(D–E)(3–6), dull violet to grayish violet. Universal veil pale violet. Basal mycelium white. Odor mild. Taste mild.

Basidiospores (11.5–) 13–17 µm × 7–10 µm, means = 13–15 × 8–9 µm, Q = 1.53–1.77, Q means = 1.59–1.78, (200 spores, 8 specimens), ellipsoid to amygdaloid, finely verrucose, plage present under SEM. *Basidia* 4-spored, clavate, (25–) 30–45 (–55) µm × 10–15 µm. *Cheilocystidia* abundant, narrowly fusiform to lageniform, brown

or grey in KOH, (40–) 50–75 (–95) µm × (10–) 15–20 (–30) µm. Pleurocystidia abundant, narrowly fusiform to lageniform, sometimes subcapitate, brown or grey in KOH, (35–) 50–90 (–120) µm × 10–25 (–40) µm. Caulocystidia present. Pileipellis a trichoderm, composed of interwoven smooth hyphae, these 9–20 µm wide, 265–415 µm high, multiseptate, with brown contents in KOH, terminal hyphae mostly blunt-ended, some lanceolate. Clamp connections present.

Ecology and distribution. Known from Costa Rica and Colombia. With *Quercus copeyensis*, *Q. seemannii*, and *Q. costaricensis* in Costa Rica and with *Q. humboldtii* and *Trigobalanus* in Colombia. 2200–2880 m alt. Fruiting late May to the end of August in Costa Rica and November in Colombia.

Other specimens examined. Colombia. Huila: Finca Merenberg, (*Quercus humboldtii*), 21 May 1987, R.E.Halling 5284 (NY). Valle del Cauca: Municipio de Pance, Parque Nacional Los Farallones, above El Topacio, (*Trigonobalanus*), 17 Nov. 1988, A.E.Franco-Molano 151 (NY). Costa Rica. San Jose: Perez Zeledon, Villa Mills, CATIE Experimental Forest, 9°33'03"N 83°40'60 W (*Quercus costaricensis*), 30 June 1998, R.E.Halling 7787 (NY 75934). Perez Zeledon, Villa Mills, CATIE Experimental Forest, 9°33'03"N; 83°40'60"W, 2840 m, (*Quercus costaricensis*), 27 June 2000, R.E.Halling 7946 (NY 460484). San Gerardo de Dota, Albergue de Montana, Savegre, ~5 km SW of Cerro de la Muerte, 9°33'02"N; 83°48'27"W, 2200 m alt., (*Quercus copeyensis* and *Q. seemannii*), 9 June 2001, R.E.Halling 8154 (NY 795935). San Gerardo de Dota, Albergue de Montana, Savegre, ~5 km SW of Cerro de la Muerte, 9°33'02"N; 83°48'27"W, 2500 m alt., (*Quercus copeyensis* and *Q. seemannii*), 8 June 1997, R.E.Halling 7709 (NY 181476). La Guaria, 9°35'60"N; 83°58'60"W, 2300 m alt., (*Quercus copeyensis* and *Q. seemannii*), 21 Aug. 1995, A.E.Franco-Molano 1393 (NY).

Discussion. *Cortinarius neotropicus* sp. nov. was treated as '*Cortinarius* sp. CR1' in Harrower et al. (2015). This species can be distinguished from *C. palatinus* sp. nov., with which it co-occurs in Costa Rica, by its smaller and finely verrucose basidiospores. In addition, *C. neotropicus* sp. nov. and *C. violaceus* both have caulocystidia, whereas other species in the *C. violaceus* group (such as *C. palatinus* sp. nov. and *C. atrotomentosus* sp. nov.) do not. Colors of the basal mycelium and context have not been recorded. There are no microscopic characters that can be used to distinguish it from *C. violaceus*, and the two species are supported as sister lineages (Fig. 1).

Cortinarius carneipallidus **Harrower & E. Horak, sp. nov.**
MycoBank MB 811661
Figs 1, 2f, 3f, 4f

Diagnosis. Similar to *Cortinarius kioloensis* but differs by its association with *Nothofagus*. Unique molecular synapomorhies at pos. 33, 157, 170, 190, 233, 249 (ITS1), 472, 480, 489, 525, 607, 670 (ITS2).

Type. NEW ZEALAND. Ruapehu: Tongariro National Park, Mt. Ruapehu, Blyth Track, (*Nothofagus solandri*) 21 April 2009, J.A. Cooper (holotype: PDD 95444).

Etymology. Means 'pale flesh', referring to the relative lack of purple pigment in the center context of this species compared to *C. violaceus*, *C. atrotomentosus*, *C. atrolazulinus*, *C. atroviolaceus* and *C. subcalyptrosporus*.

Description. Pileus 49–100 mm wide, surface dry, convex then plano–convex, tomentose to fine scaly, dark violet (16D5–8), paler at margin, red in KOH. Lamellae crowded, emarginate-adnexed, average thickness, broad, deep violet. Stipe 96–175 mm long, 5–11 mm thick at apex, 12–30 mm thick at base, subequal, sometimes slightly bulbous, tapering gradually from base to apex, pale violet (17C3–6), covered in copious veil material. Universal veil pale violet (same color as stipe), leaving bands on the stipe. Basal mycelium pale violet. Context white flecked with violet in pileus and lower half of stipe, upper half of stipe violet flecked with white, sometimes white with violet cortex, younger specimens violet flecked with white and only fully white in the base.

Basidiospores (9–) 10–12 (–13) µm × (7–) 8–9 (–9.5) µm, means = 10.5–12 µm × 8–8.5 µm, Q = 1.19–1.64, Q means = 1.30–1.45, (224 spores, 8 specimens). Ellipsoid to amygdaloid, strongly verrucose, plage present. Basidia 4 spored, clavate, (35–) 40–50 (–55) µm × (9–) 10–12 (–13) µm. Cheilocystidia abundant, narrowly fusiform to lageniform, brown in KOH, 60–90 (–100) µm × 15–20 (–25) µm. Pleurocystidia abundant, narrowly fusiform to lageniform, sometimes subcapitate, brown in KOH, (40–) 55–80 (–100) µm × (10–) 15–25 (–30) µm. Caulocystidia not seen. Pileipellis a trichoderm, composed of smooth hyphae 10–25 µm wide, 350–370 µm long, multiseptate, brown content in KOH, terminal cells bottle-shaped, clavate, lanceolate or ending bluntly. Clamp connections present.

Ecology and distribution. Under *Nothofagus* in New Zealand. Fruiting April to June.

Other specimens examined. New Zealand. Wellington: Kapiti Coast, Tararua Forest Park (*Nothofagus*), 16 May 2009, K. Hosaka (PDD 98057). Canterbury: Selwyn Klondyke Corner (*Nothofagus cliffortioides*), 5 June 2010, P. White (PDD 95823). Waikato: Taupo, Erua Forest National Park, Erua Forest rest area (*Nothofagus*), 8 Apr. 2005, L. Fischer (PDD 82693). Taupo, Mt. Ruapehu, Tongariro National Park, Whakapapanui Track, Buller 28 Apr. 2001, E. Horak (PDD 72636). West Coast: Buller, Springs Junction, Lake Christabel Track, 14 Apr. 2000, E. Horak (PDD 71219). Buller, Reefton, Victoria Forest Park, Tawhai Walk, (*Nothofagus*) 13 May 2006, E. Horak (PDD 88638). Buller, South Charleston, Tiropahi Track (*Nothofagus*) 8 May 2010, A. Roberts (PDD 88995).

Discussion. *Cortinarius carneipallidus* sp. nov. differs from *C. subcalyptrosporus* by the absence of calyptrate basidiospores. The association with *Nothofagus* distinguishes this species ecologically from *C. atroviolaceus*, which likely associates with members of the Myrtaceae and/or Fagaceae in Malaysia. The context is hygrophanous purple in young specimens. In older specimens, it is hygrophanous grey or white in the pileus and base and only purple at the stipe apex. The only other species described from Indonesia or Australasia to have whitish flesh is *C. kioloensis*. It differs from *C. kioloensis*, with which it forms a sister group relationship (Fig. 1), by its association with *Nothofa-*

gus. *C. carneipallidus* has a wider pileus and longer stipe than *C. atrolazulinus*. The width of the basidiospores is wider than those in *C. atrolazulinus* as well.

Cortinarius carneipallidus sp. nov. has been variously identified as *C. atroviolaceus*, *C. atrolazulinus*, *C. subcalyptrosporus*, *C. violaceus* and *Cortinarius* sp. The species was treated as '*C. violaceus* sensu Moser 1986' in Harrower et al. (2015) but differs from north temperate *C. violaceus* by the absence of caulocystidia and association with *Nothofagus*. However, the name '*C. violaceus* sensu Moser 1986' was applied based on interpretation of the protologue only, and as no specimens of '*C. violaceus* sensu Moser 1986' were examined, we do not intend to synonymize the former with *C. carneipallidus*.

***Cortinarius atrotomentosus* Harrower, sp. nov.**
MycoBank MB 811662
Figs 1, 2c, 3g, 4g

Diagnosis. Similar to *Cortinarius violaceus* (L.: Fr.) Gray but differs by having smaller spores and shorter basidia as well as an absence of caulocystidia. Unique molecular synapomorphies at pos. 71 (ITS1), and 606 (ITS2) are present in our alignment.

Type. USA, Florida: Wakulla Co., Crawfordville, Apalachicola National Forest (30°12'06"N; 84°26'33"W), on soil under *Quercus virginiana*, 4 Dec. 2010, TFB 13848, (holotype: TENN 065527).

Etymology. Meaning 'dark-tomentose' in reference to the dark coloration of the fruiting body.

Description. Pileus 26–91 mm wide, surface dry, tomentose to fine scaly, dark violet (17F3) to dark brown in age (7F3), red in KOH. Lamellae adnexed, not sinuate, close to subdistant, thin, ventricose, dark violet (17F3). Stipe 75–131 mm long, 8–18 mm thick at apex, 17–26 mm thick at base, ventricose, silky-glabrous, olive brown (4E6) to brownish grey in age (5D2). Basal mycelium lilac (16B4) to greyish magenta (14D3). Context purple grey (13E2) to reddish brown (10D4). Smell mild. Taste none. Basidiospores (9–) 10.5–13 (–14.0) µm × (6–) 7–8 µm, means = 10.5–12 µm × 6–8 µm, *Q* = 1.43–1.67, *Q* means = 1.50–1.53, (70 spores, three specimens), ellipsoid to amygdaloid, strongly verrucose, plage present under SEM. Basidia 4-spored, clavate, 20–30 × 10–12 µm. Cheilocystidia abundant, narrowly fusiform to lageniform, brown in KOH, 50–70 (–80) µm × 15–25 µm. Pleurocystidia abundant, narrowly fusiform to lageniform, brown in KOH, 43–65 (–70) × 15–20 µm. Caulocystidia not seen. Pileipellis a trichoderm, hyphae 6–20 µm wide, 185–370 µm high, multiseptate, brown content in KOH, terminal hyphae mainly blunt-ended, some lanceolate or aciculate. Clamp connections present.

Ecology and distribution. Under *Quercus virginiana*. Known only from Apalachicola National Forest, Crawfordville, Florida, USA. Fruiting early December.

Other specimens examined. USA. Florida: Wakulla Co., Crawfordville, Apalachicola National Forest (30°12'07"N; 84°26'33"W), (*Quercus virginiana*), 2 Dec. 2010, D.Lewis & B.Petty TFB 13840 (TENN 065527).

Discussion. *Cortinarius atrotomentosus* sp. nov. was treated as '*Cortinarius* sp. NA1' in Harrower et al. (2015). This species can be differentiated from *C. violaceus* by its dark violet to dark brown pileus and the olive brown to brownish grey stipe. The context of *C. violaceus* is violet to greyish, not mauve as is *C. atrotomentosus* sp. nov. Caulocystidia were not found on this species whereas they are present in *C. neotropicus* sp. nov. and *C. violaceus*. The current Gulf Coast geographic distribution of *C. atrotomentosus* sp. nov., where it associates with *Quercus*, does not overlap with the more northerly distribution of *C. violaceus*. The species differs from *C. palatinus* sp. nov., with which it appears to be most closely related (Fig. 1), by its location (Gulf Coast region) and its dark exterior. The basal mycelium is the only part of the fruiting body that could be described as pale violet.

Species inquirendae

Cortinarius hercynicus (Pers.) M.M.Moser 1967

Cortinarius hercynicus differs from *C. violaceus* s.s. by having smaller and broader basidiospores and occurrence in coniferous forests. Harrower et al. (2015) did not find a molecular difference between *C. hercynicus* and *C. violaceus*, but taxon sampling of *C. hercynicus* was not adequate. Brandrud (1983) treated *C. hercynicus* as a variety of *C. violaceus*. However, in Harrower et al. (2015) samples of *C. violaceus* s.l. recorded from coniferous forests and separately in hardwood forests failed to form monophyletic groups suggesting that host association is of no taxonomic significance. Thus, current data suggest *C. hercynicus* is synonymous with *C. violaceus*.

Species excludendae

Cortinarius austroviolaceus Gasparini 2001

Fig 2i, 3i, 4i

This species is phylogenetically placed outside of *Cortinarius* sect. *Cortinarius* (Harrower et al. 2015). In comparison to species within the section, the basidiospores lack a plage (Fig. 3i), the basidiospore ornamentation differs (less coarsely ornamented) at the SEM level, and pleurocystidia are absent.

Cortinarius gayi E. Horak 1980

Fig 2h

The purple color and densely squamulose or fibrillose pileus is consistent with most other species in sect. *Cortinarius*. However, *C. gayi* lacks both pleurocystidia and

cheilocystidia, and a plage is reportedly absent from the basidiospores. This species may have closer to affinities to *C. austroviolaceus* than sect. *Cortinarius*.

***Cortinarius paraviolaceus* M.M.Moser 1987**

This species is described as having a pileus that is "rather intensely violaceus…the center becoming dull tawny ochraceus" (Moser 1987). The stipe is described as "violaceus tomentose at the base, otherwise brownish fibrillose with the cortina". Pleurocystidia are rare and no cheilocystidia were observed (Moser 1987). The pileus is "not strongly squarrose-fibrillose-squamulose". These characters, taken together, are not consistent with the *C. violaceus* group.

***Cortinarius jenolanensis* Wood 2009**

This species has a smooth pileus and cheilocystidia, but lacks pleurocystidia. This species may have closer to affinities to *C. austroviolaceus* than sect. *Cortinarius*.

***Cortinarius atrolazulinus* M.M. Moser** sensu **Soop 2008**

Known collections (not examined by the authors): New Zealand. Southland: Southland, Fiordland, Lake Gunn Track, (*Nothofagus*), 5 May 2001, K. Soop KS CO1223 (PDD103879; GenBank KF727372; KF727328). Taupo: Taupo, Kaimanawa Forest Park, Cascade Hut Track, (*Nothofagus*) 9 May 2009 K. Soop KS CO1917 (PDD97542).

C. atrolazulinus was described by Moser (1987) from *Nothofagus* forest in New Zealand. These two collections match Moser's description well, which includes the presence of cheilocystidia and pleurocystidia. Phylogenetic analyses (not shown) place it in an unknown clade outside of *Cortinarius* sect. *Cortinarius*. Further morphological and genetic analyses are needed to correctly classify this species. Attempts to sequence the type collection of *C. atrolazulinus* (ZT 69-276) were unsuccessful.

***Cortinarius atroviolaceus* M.M. Moser** sensu **Shirley**

New Zealand: Auckland, Kauri Point Reserve. (*Leptospermum*) C. Shirley AK 369 (PDD; GenBank KT444633; KT444634).

Pileus fibrillose, not tomentose. Epicutis not a trichoderm, hyphae 6-14 µm wide, blue extracellular pigment clumps. Purple intracellular pigment readily dissolving in KOH. Spores 7.5-8.5 x 4-5 µm. Cheilocystidia and pleurocystidia present. This species shares 90% ITS sequence identity with one member of *Cortinarius* sect. *Cortinarius* (*C. carneipallidus*) at best. It shows higher sequence identity to members outside of the

section. Phylogenetic analyses (not shown) could not place it within the section with confidence. *Cortinarius jenolanensis* has wider spores and lacks pleurocystidia, compared to this species. *Cortinarius atroviolaceus* M.M. Moser has much longer and wider spores. As there is only one collection of this species, with inadequate documentation, more work needs to be done to document and classify this species.

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